Two newly recorded species of *Mesaphorura* (Collembola: Tullbergiidae) from China

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Abstract: Two newly recorded species in the genus *Mesaphorura* Börner, 1901 from China are described: *Mesaphorura hylophila* Rusek, 1982 and *Mesaphorura pacifica* Rusek, 1976. The important morphological characters of these Chinese specimens are described in details. A key to Chinese *Mesaphorura* species is provided.

Key words: springtails; postantennal organ; pseudocellus; key; taxonomy

中国美土蛛属二新纪录种记述（弹尾纲：土蛛科）

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摘要：记述美土蛛属 *Mesaphorura* Börner, 1901 跳虫 2 中国新纪录种：林栖美土蛛 *Mesaphorura hylophila* Rusek, 1982 和太平洋美土蛛 *Mesaphorura pacifica* Rusek, 1976。描述了中国标本的形态特征，编制了中国美土蛛属种类的检索表。

关键词：跳虫；角后器；假眼；检索表；分类

Introduction

The family Tullbergiidae Bagnall, 1947 contains a group of tiny euedaphic collembolans with approximately 200 species reported worldwide (Bellinger *et al.* 1996–2017; Dunger & Schlitt 2011). However, the Chinese tullbergiids are poorly known with only five species recorded to date (Gao 2007; Bu *et al.* 2013; Bu & Gao 2015). During the study of collembolan collections from several natural reserves in Hebei Province, North China, two species in the genus *Mesaphorura* Börner, 1901, new to the Chinese fauna were identified and are described in this paper.

Material and methods

Specimens were collected by Berlese-Tullgren funnels and preserved in 80% ethanol. The

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material was mounted on slides in Hoyer's solution and dried in an oven at 60 °C for identification. The photos were taken by a digital camera installed on a microscope. All specimens are deposited in Shanghai Natural History Museum (SNHM), Shanghai, China. Abbreviations used in the descriptions: Th. — thoracic segment, Abd. — abdominal segment, Ant. — antennal segment, Asp. — anal spine, s — sensillum, PAO — postantennal organ, a — anterior setae, m — medial setae, ms — microsensillum, p — posterior setae, pl — pleural setae, pso — pseudocelli.

Taxonomy

Family Tullbergiidae Bagnall, 1947

Genus *Mesaphorura* Börner, 1901

Mesaphorura Börner, 1901: 24. Type species: *Mesaphorura krausbaueri* Börner, 1901.

Diagnosis. The genus *Mesaphorura* Börner, 1901 is characterized by the two large sensory clubs, two rods behind a protecting integumentary fold on Ant III, five differently thickened sensilla on Ant IV, PAO on head with 18–55 simple, rod-like vesicles lying in two rows, pseudocelli star-like (type I), pseudocellar formula predominantly 11/011/10011, Abd VI with crescentic ridges, and the two anal spines on short papillae. For many species, only females are known.

Distribution. Holarctic, some species cosmopolitan.

Key to Chinese *Mesaphorura* Börner, 1901

1. Abd. V with spindle-like sensilla p3 2
-. Abd. V with slim sensilla p3 ..... *M. pacifica* Rusek
2. Th. III with seta a2 3
-. Th. III without seta a2 ..... *M. hylophila* Rusek
3. Abd. IV with m4 seta, anal lobe with setae l2' and l3' ..... *M. yosii* (Rusek)
-. Abd. IV with m4 and m5 setae, anal lobe with seta l3' only, l2' absent ..... *M. krausbaueri* (Börner)

1. ***Mesaphorura hylophila* Rusek, 1982** (Figs. 1–9, Table 1), new record to China

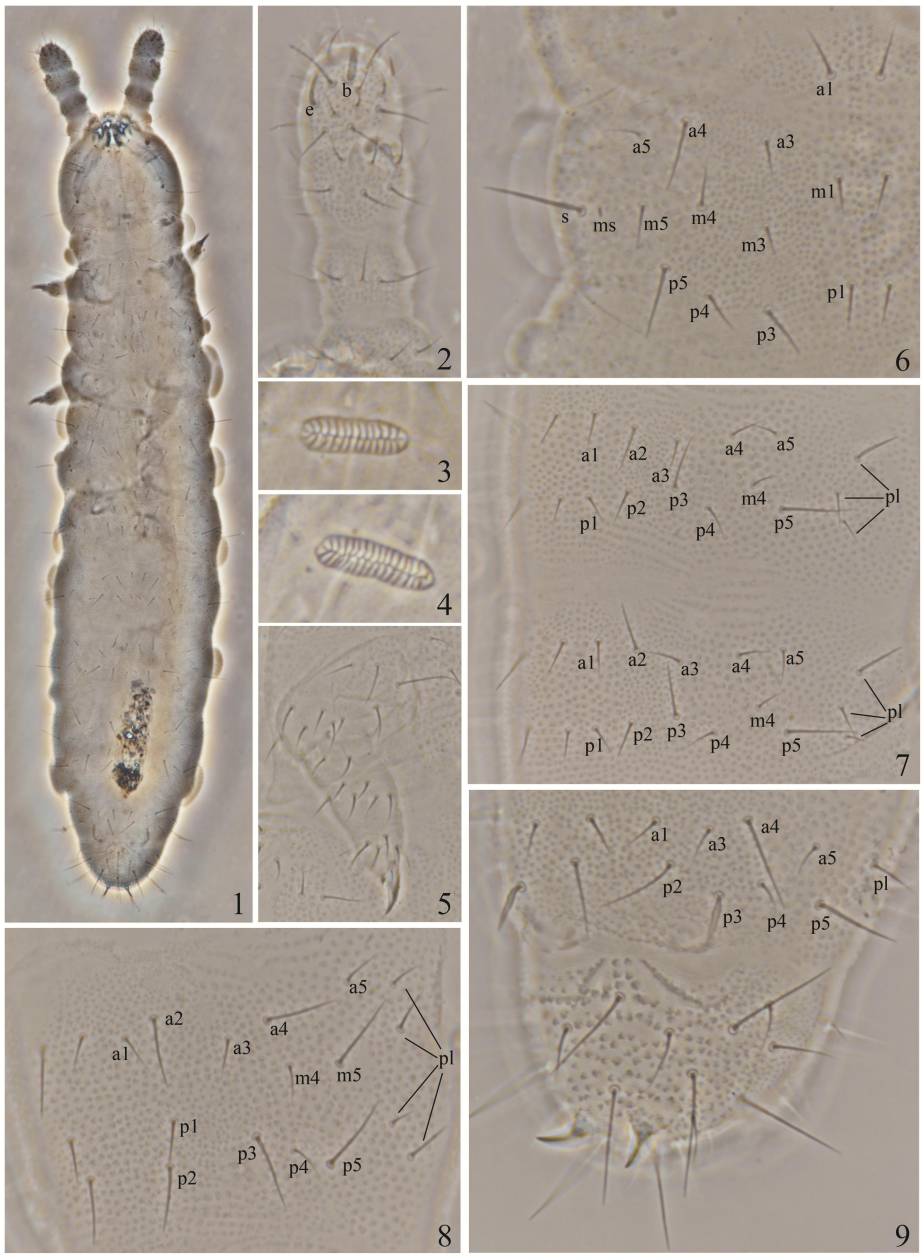
Mesaphorura hylophila Rusek, 1982: 14.

Mesaphorura hylophila Fjellberg, 1998: 141.

Mesaphorura hylophila Dunger & Schlitt, 2011: 64.

Specimens examined. 7♀, slides nos. HB-C2016001, HB-C2016021–HB-C2016025, 3 juvenile, slides nos. HB-C2016002, HB-C2016022, **China**, Hebei Province, Chengde, Weichang County, Mulanweichang Natural Reserve, Wudaogou, extracted from soil samples, 41°99'N, 117°04'E, elev. 1300 m, 11-VII-2016, coll. Yun BU. 33♀, 2 juveniles, slides nos. HB-C2016003–HB-C2016006, HB-C2016009–HB-C2016011, HB-C2016027–HB-C2016029, **China**, Hebei Province, Chengde, Pingquan County, Liaoheyuan Natural Reserve, extracted from soil samples, 41°32'N, 118°44'E, elev. 1230–1500 m, 13-VII-2016, coll. Yun BU. 1♀, no. HB-C2016012; **China**, Hebei Province, Chengde, Xinglong county, Wulingshan Natural Reserve, extracted from soil samples of broad-leaved forests, 40°53'N, 117°50'E, elev. 1200 m, 17-VII-2016, coll. Yun BU. 2♀, slides no. HB-C2016065, HB-C2016067; **China**, Hebei Province, Xingtai, Niutougou, extracted from litter and humus samples, 37°71'N, 113°71'E, elev. 1011 m, 10-VII-2016, coll. Qibao YAN. 1♀, 3 juvenile, slides no. HB-C2016071; **China**,

Hebei Province, Shexian, Pianchengxijian, extracted from litter and humus samples, 36°65'N, 113°50'E, elev. 874 m, 13-VII-2016, coll. Qibao YAN.



Figures 1–9. *Mesaphorura hylophila* Rusek, 1982. 1. Habitus, dorsal view; 2. Antenna, dorsal view; 3, 4. Postantennal organ; 5. Leg III; 6. Metanotum, left side; 7. Tergites of Abd. II and III, right side; 8. Tergite of Abd. IV, right side; 9. Tergites of Abd. V and VI.

Diagnosis. *Mesaphorura hylophila* Rusek, 1982 is characterized by the absence of a2 seta on metanotum, 24–32 simple vesicles on PAO, pseudocellar formula 11/011/10011, all pseudocelli of type I, pseudocelli on Th II and III located between setae m5/p5, the absence of

seta a2 on Abd. V, the spindle-like sensory seta p3 on Abd. V, and the presence of m4 and m5 setae on Abd. IV. Only females known.

Description. Adult body 500 μm long in average (470–520 μm, n = 20) (Fig. 1). Setae well differentiated. Granulations on integument is fine (0.5–1.0 μm) (Figs. 6–9). Pseudocellar formula: 11/011/10011. All pseudocelli type I, 7–8 μm in diameter; on Th. II and III between setae m5/p5.

Head seta a0 present (5–6 μm), c1 absent, oc2 as macroseta (10–11 μm), and sd5 as mesoseta (5–6 μm). Postantennal organ narrow, 14–16 μm long and 4–5 μm wide, composed of 28–32 elliptical vesicles arranged in two rows (Figs. 3, 4). Labrum with 4/5/4 setae. Labium with five papillae, six apical guard setae, six proximal setae, four basomedial setae, and five basolateral setae. Ventral head with 3+3 axial setae.

Table 1. Adult chaetotaxy of *Mesaphorura hylophila* Rusek, 1982

		Thorax			Abdomen				
Segments		I	II	III	I	II	III	IV	V
Dorsal	a	-	10	8[1]	10	10	10	10	8[4]
	m	8	8	8	2[2]	2[2]	2[2]	4[3]	-
	p	-	8	8	10	10	10	10	8[5]
	pl	2	3	3	2	3	3	4	1
Ventral		0	2	2	12	17–19	18–20	20–25	(13–16)+ 5[6]

[1] seta a2 absent; [2] seta m4 present; [3] seta m4 and m5 present; [4] seta a2 absent; [5] sensory seta p3 spindle-like; [6] 13–16 surrounding setae, 5 setae on female genital plate.

Antenna (60–65 μm) shorter than head (70 μm). Ant. I and II with 7 and 11 setae respectively. Ant. segment IV with five slightly thickened sensilla a–e, sensillum b thick (6 μm), sensilla d, e slender (Fig. 2), small microsensillum, subapical organite and one large apical vesicle present. Antennal organ III consists of two small sensory rods concealed behind one lower papilla and two thick sensory clubs bent toward each other, with four guard setae.

Legs without clavate tibiotarsal hairs (Fig. 5). Subcoxa, coxa, trochanter, femur and tibiotarsus with 0/3/3; 3/7/7; 6/6/5; 9/9/9; 11/11/11 setae on Leg I, II and III, respectively. Claw 10 –11 μm long, with short empodial appendage (2–3 μm). Anal spines 7–9 μm long (Fig. 9).

Adult chaetotaxy given in Table 1. Length of setae on pronotum as 6–7 μm for m1 and m3, 11–15 μm for m2 and m4. Microsensilla present on Th. II–III, and lateral sensory setae s 15–16 μm long (Fig. 6). Thorax with 0, 2, 2 ventral setae. Abd. I–III each with 2+2 axial setae dorsally, setae m4 present on Abd. I–III, with one pleural seta on Abd. II and III thick (Fig. 7). Abd. IV with setae m4 and m5 (Fig. 8). Abd. V with sensory seta p3 (8–9 μm) spindle-like; seta a2 absent and p4 as microseta (Fig. 9). Crescentic ridges on Abd. VI present (Fig. 9).

Ventral tube with 4+4 apical setae and 2+2 basal setae. Number of ventral setae on Abd. II, III and IV variable, with 17–19, 18–20, and 20–25 setae respectively. Anal lobes with seta 12' and l3'. Female genital plate with 5 setae. Males unknown.

Distribution. China (Hebei); widely distributed in Palaearctic (Norway, Greenland, Scandinavia, Spain, Poland, Italy, Slovakia, Germany, Russia).

Type locality. Czech (Central Bohemia).

Remarks. Chinese specimens of *M. hylophila* have more vesicles on PAO (28–32 vesicles) than in types (24 vesicles). The species is probably widely distributed in China.

2. ***Mesaphorura pacifica* Rusek, 1976** (Figs. 10–18, Table 2), new record to China

Mesaphorura pacifica Rusek, 1976: 30.

Mesaphorura pacifica Rusek, 1981: 66.

Mesaphorura pacifica Dunger & Schlitt, 2011: 76.

Specimens examined. 3♀, slides nos. HB-C2016021, HB-C2016023, HB-C2016025, 1 juvenile, slides no. HB-C2016024, **China**, Hebei Province, Chengde, Weichang County, Mulanweichang Natural Reserve, extracted from soil samples, 41°99'N, 117°04'E, elev. 1300 m, 11-VII-2016, coll. Yun BU. 5♀, 2 juveniles, nos. HB-C2016003, HB-C2016005, HB-C2016006, HB-C2016009; **China**, Hebei Province, Chengde, Pingquan County, Liaoheyuan Natural Reserve, extracted from soil samples, 41°32'N, 118°44'E, elev. 1230–1500 m, 13-VII-2016, coll. Yun BU.

Diagnosis. *Mesaphorura pacifica* Rusek, 1976 is characterized by the absence of a5 seta and the presence of m2 and m3 setae and on Abd. I, the presence of m4 and m5 seta on Abd. IV, 30 vesicles on narrow PAO, pseudocellar formula as 11/011/10011, all pseudocelli of type I, pseudocelli on Th II and III located between setae p3/p4, seta a2 on Abd. V as mesoseta, and the slim sensory seta p3 on Abd. V. Only females known.

Description. Adult body 590 μm long in average (540–650 μm, n = 5) (Fig. 10). Setae well differentiated. Granulations on integument is fine (0.5–1.0 μm) (Figs. 11, 12, 15, 16). Pseudocellar formula: 11/011/10011. All pseudocelli type I, 7 μm in diameter, on Th. II and III between setae p3/p4 (Fig. 12).

Head seta a0 present (9–10 μm), c1 absent, oc2 as macroseta (15 μm), and sd5 as mesoseta (8–6 μm) (Fig. 11). Postantennal organ narrow, 16–19 μm long and 4–5 μm wide, composed of 30 elliptical vesicles arranged in two rows (Figs. 13). Labrum with 4/5/4 setae. Labium with five papillae, six apical guard setae, six proximal setae, four basomedian setae, and five basolateral setae. Ventral head with 3+3 axial setae.

Table 2. Adult Chaetotaxy of *Mesaphorura pacifica* Rusek, 1976

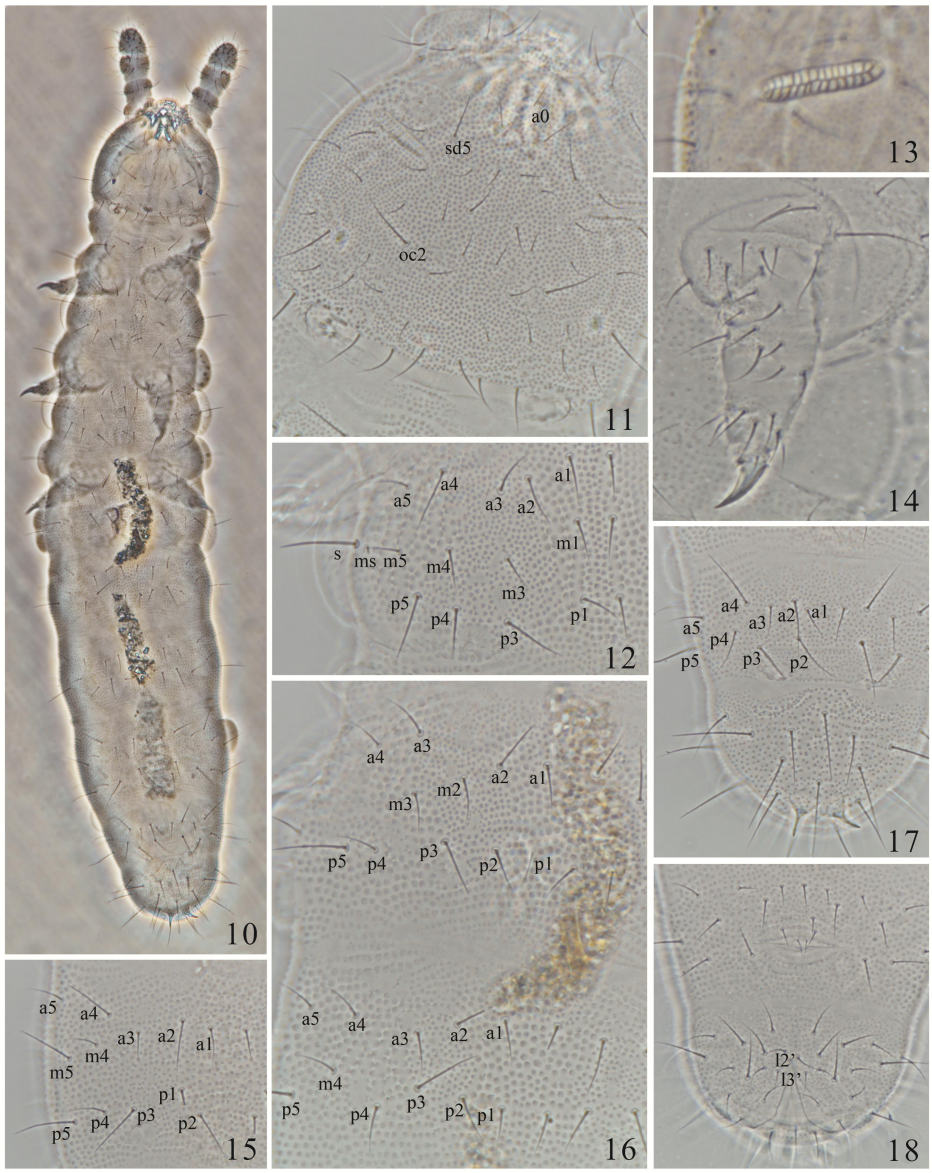
		Thorax			Abdomen				
Segments		I	II	III	I	II	III	IV	V
Dorsal	a	-	10	10	8[1]	10	10	10	10[5]
	m	8	8	8	4[2]	2[3]	2[3]	4[4]	-
	p	-	8	8	10	10	10	10	8[6]
	pl	2	3	3	2	3	3	4	1
Ventral		0	2	2	12	17–19	18–20	20–25	(13–16)+ 5[7]

[1] seta a5 absent; [2] seta m2 and m3 present; [3] seta m4 present; [4] seta m4 and m5 present; [5] seta a2 as mesoseta; [6] sensory seta p3 slim; [7] 13–16 surrounding setae, 5 setae on female genital plate.

Antenna (66–73 μm) shorter than head (80–93 μm). Ant. I and II with 7 and 11 seate respectively. Ant. segment IV with five slightly thickened sensilla a–e, sensillum d slightly slender, small microsensillum, subapical organite and one large apical vesicles present. Antennal organ III consists of two small sensory rods concealed behind one lower papilla and two thick sensory clubs bent toward each other, with four guard setae.

Legs without clavate tibiotarsal hairs (Fig. 14). Subcoxa, coxa, trochanter, femur and tibiotarsus with 0/3/3; 3/7/7; 6/6/5; 9/9/9; 11/11/11 setae on Leg I, II and III, respectively. Claw 12–13 μm long, with short empodial appendage (2–3 μm). Anal spines 8–10 μm long (Fig. 17).

Adult chaetotaxy given in Table 2. Length of setae on pronotum as 6–10 μm for m1 and m3, 15–17 μm for m2 and m4. Microsensilla present on Th. II–III, and lateral sensory setae s 16–20 μm long (Fig. 12). Thorax with 0, 2, 2 ventral setae. Abd. I–III each with 2+2 axial setae dorsally, setae m2 and m3 present on Abd. I, m4 present on Abd. II–III (Figs. 16). Abd. IV with setae m4 and m5 (Fig. 15). Abd. V with slim sensory seta p3 (15–18 μm), seta a2 as mesoseta and p4 as mesoseta (Fig. 17). Crescentic ridges on Abd. VI present (Fig. 17).



Figures 10–18. *Mesaphorura pacifica* Rusek, 1976. 10. Habitus, dorsal view; 11. Head, dorsal veiw; 12. Metanotum, left side; 13. Postantennal organ; 14. Leg III; 15. Tergite of Abd. IV, left side; 16. Tergites of Abd. I and II, left side; 17. Tergites of Abd. V and VI; 18. Sternites of Abd. V and VI.

Ventral tube with 4+4 apical setae and 2+2 basal setae. Number of ventral setae on Abd.

II, III and IV variable, with 19–20, 20–22, and 24–25 setae respectively. Anal lobes with seta 12' and l3' (Fig. 18). Female genital plate with 5 setae. (Fig. 18). Males unknown.

Distribution. China (Hebei); North America; North Africa; Iraq (Bagdad).

Type locality. Canada (British Columbia, Vancouver Island).

Remarks. *Mesaphorura pacifica* Rusek, 1976 was originally described from Vancouver Island of Canada. In Asia, it was only recorded in Iraq. The Chinese specimens are slightly larger (0.59 mm) than the types (0.53 mm), but their morphological characters are exactly the same as the original description. In China, it occurrs together with *M. hylophila*, but is relatively rare, with only 11 specimens among 70 *Mesaphorura* specimens.

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